OBJECTIVE 7: PLUME DOSE PROJECTION

OBJECTIVE

Demonstrate the capability to develop dose projections and protective action recommendations regarding evacuation and sheltering.

INTENT

This objective is derived from NUREG-0654 which provides that OROs should have the capability to estimate integrated dose from exposure rates and for comparing these estimates with protective action guides. (See evaluation criteria in Planning Standards I. and N.)

Early recommendations to evacuate and shelter are usually based on plant conditions and associated recommendations by the licensee. Recommendations by the licensee typically prescribe evacuation to a predetermined distance (e.g., a two to three mile radius and five miles in downwind sectors) and sheltering to a greater distance. These recommendations may be provided by the licensee to a State or local government dose assessment group for evaluation before being provided as recommendations to the ORO decision makers or may be provided directly to ORO decision makers.

In most cases, **initial** information from the licensee on plant conditions will not contain sufficient detail for the dose assessment group to calculate or otherwise estimate projected dose. However, if information is made available by the licensee regarding the potential release, or for calculating the potential release, it is appropriate for the dose assessment group to project the offsite dose. If these data are not provided, it is generally appropriate for the dose assessment group to base the initial protective action recommendations (PAR) on recommendations made by the licensee. **Subsequent** decisions to evacuate or shelter should be made on the basis of a comparison of projected dose to the protective action guides (PAG).

When sufficient data are available, the dose assessment group should demonstrate the capability to make plume pathway dose projections based on information from the licensee regarding releases or potential releases or on field measurements. The purpose of these dose projections is to determine if initial protective actions that were based on plant conditions and recommendations from the licensee are adequate. This activity is supported by receipt from the licensee of information concerning what is being released from the plant (or what may be released), meteorological conditions, the licensee's own dose projections, and field monitoring data.

This objective is closely related to Objective 6, Field Radiological Monitoring - Ambient Radiation Monitoring, which addresses the provision of field monitoring data essential for plume pathway dose projection, Objective 8, Field Radiological Monitoring - Airborne Radioiodine and Particulate Activity Monitoring, which addresses the measurement of samples from an airborne plume, and Objective 9, Plume Protective Action Decision Making, which uses information from this objective as a basis for protective action decisions.

DEMONSTRATION CRITERIA

NUREG	CRITERION
I.8.,10.,11.	**1. Plume location and dose are projected through use of models, data from the field, and data supplied by the licensee, and appropriate protective action recommendations are developed.**

Explanation

During the initial stages following notification of plant conditions warranting offsite protective actions, the dose assessment group should demonstrate the capability to use appropriate means, described in the plan, to make PARs to decision makers based on information and recommendations from the licensee. This should include either the calculation of projected dose and exposure rates based on information from the licensee, or use of other information and recommendations from the licensee to determine the areas where protective actions are justified.

When simulated release data and meteorological data are provided by the licensee, the dose assessment group should demonstrate the capability to use these data in either mathematical or computer dose models, previously calculated tables, or curves to project dose and exposure rate from the plume. When a computer is used for dose projection, the dose assessment group should demonstrate a backup capability for dose projection.
For example, this may be demonstrated by the use of an alternate computer system, programmable calculator, or previously calculated tables or curves.

The types of calculations to be demonstrated depend on the data available and the PAGs in the plan. In all cases, calculation of projected dose should be demonstrated. However, if the dose projections are based on release data, gamma exposure rate and iodine concentrations should also be calculated so that when environmental measurements become available, they can be compared to the calculated values. In some cases, PAGs may be expressed in the quantities "whole body dose equivalent from external exposure to gamma radiation" and "committed dose equivalent to the thyroid" from inhalation. In other

cases, the PAGs may be expressed in the quantities "dose equivalent from external gamma exposure" plus "committed effective dose equivalent from inhalation" with a separate PAG for the thyroid expressed in the quantity "committed dose equivalent". Projected doses should be expressed in the same quantities and units as the PAGs to which they will be compared. Projected gamma exposure rates in the plume should be expressed in the same units as read by the survey meters used by field monitoring teams [typically milliroentgens per hour (mR/h) or Roentgens per hour (R/h)].

PARs based on comparison of projected doses to the PAGs should be promptly transmitted to decision makers in the form of plots on a map or other prearranged format and within the time frame required by the plan. However, if early recommendations are made directly to the decision makers by the licensee, or if such recommendations are made by the dose assessment group based on information and recommendations by the licensee, it is not necessary to complete dose projections and reassess recommendations to support initial protective action decisions. However, the alert and notification time sequences should be complied with as addressed in Objective 10, Alert and Notification.

When the licensee provides the dose assessment group information on only the plant conditions, potential offsite doses, or PARs, the dose assessment group should demonstrate the capability to consider the potential dose to the population and promptly transmit the recommendations to the decision makers in time for them to make decisions within the time frame provided for in the plan. The use of plots on a map or other prearranged format should be used for transmitting the information and recommendations.

Where the projected dose is determined by both the licensee and the offsite dose assessment group, and the two doses differ by greater than a factor of 10, the dose assessment group should demonstrate the capability to investigate the difference by discussing with the licensee the input data and assumptions used, the use of different models, or other possible reasons.

After the initial PARs, additional data may become available to justify revisions to the PARs. Such data may include changes to the potential or simulated release, changes in actual or predicted meteorological conditions, or environmental measurements in the plume. The dose assessment group should demonstrate the capability to use these data to revise projected doses and exposure rates and the associated PARs.

The dose assessment group should demonstrate the capability to compare measured peak exposure rates and measure iodine concentration in the plume, or in evacuated areas downwind, at particular times and locations downwind to those that were projected based on simulated releases. They should then evaluate whether these comparisons indicate that the release rate is significantly different or is going in a different direction than estimated by the licensee. If these comparisons indicate that the release is significantly higher than previously estimated, the dose assessment group should provide revised PARs to the

decision makers. Likewise, peak exposure rate measurements in the plume, peak exposure rate measurements in evacuated areas downwind, or exposure rate measurements at the plume edges indicate that the plume is going in a different direction than previously estimated, the dose assessment group should demonstrate the capability to evaluate these data and determine whether revised PARs should be provided to the decision makers.

When air samples are taken by field teams, gamma exposure rate measurements should be made at the sampling location while the sample is being taken. If the dose assessment group receives results of field analyses of Iodine-131 in these samples and the associated gamma exposure rates, they should demonstrate the capability to evaluate whether a consistent relationship exists between the gamma exposure rate and the Iodine-131 concentration. When such a relationship exists, an adjustment factor should be calculated for estimating the thyroid dose to emergency workers entering the plume without KI protection, based on the dosimeter reading.

Extent of Play

Under this criterion, all activities should be carried out as in an actual emergency. For situations where PARs are made solely on the basis of plant conditions and potential releases, no simulated release information and no field monitoring data will be available to use as a basis for dose projections. In this case, controller injects should be provided as needed to drive the response. Data for these injects should be provided as part of the scenario package.

When arrangements have been made for licensee field monitoring teams to collect peak exposure rate measurements these data should be used for dose projections. In this case, licensee data should be obtained for use in dose projection.

NUREG	CRITERION
N.1.a.	**2. All activities described in the demonstration criteria for this objective are carried out in accordance with the plan, unless deviations are provided for in the extent-of-play agreement.**

Explanation

Responsible OROs should demonstrate the capability to follow policies, implement procedures, and utilize equipment and facilities contained in the plans.

Extent of Play

Under this criterion, all activities should be carried out as specified in the plan, unless deviation from the plan is provided for in the extent-of-play agreement.

CLARIFICATION OF TERMS

The following definitions describe the limited meaning of terms in the context of the Exercise Evaluation Methodology and may vary from the full technical definition for all circumstances.

Committed dose refers to the dose that will be received over a period of 50 years from the ingestion or inhalation of a particular quantity of a radionuclide or a specific mix of radionuclides.

Committed effective dose equivalent refers to the sum of the 50-year committed doses to individual organs from inhalation (or ingestion) of radionuclides, where the individual organ doses have been adjusted so that the associated risk of fatal cancer can be added to the risk of fatal cancer from whole-body dose.

Controller inject refers to the introduction of events, data, and information into exercises to drive the demonstration of objectives.

Dose equivalent refers to radiation dose to the whole body or a single organ that has been adjusted to make it equivalent in risk of cancer to the amount of dose from gamma radiation that would cause the same risk of cancer. No adjustments are required for the predominate types of radiation associated with reactor accident source terms.

Exposure rate refers to the amount of gamma radiation that a individual would receive in one hour as measured in air (typically expressed in units of milliroentgens per hour or Roentgens per hour).

Monitoring refers to checking radiation levels, usually by counting ambient radiation.

Plume dose projections are estimates of dosage to the public from exposure to the plume, over a period of time, in the absence of initiating protective actions.

Potential dose refers to an amount of radiation dose that could result from a particular set

of plant conditions but is not supported by estimated or measured releases or measured environmental levels.

Projected dose is the estimated or calculated amount of radiation dose to an individual from exposure to the plume and/or deposited materials, over a period of time, in the absence of protective actions.

Protective action guide (PAG) refers to projected dose to an individual in the general population that warrants the implementation of protective action. Specific PAG's have been recommended in terms of the level of projected dose that warrants the implementation of evacuation and sheltering, relocation, and limiting the use of contaminated food, water, or animal feed.

Radionuclide refers to a radioactive isotope of a particular element.

Relocation refers to a protective action, taken in the post-emergency phase, through which individuals not evacuated during the emergency phase are asked to vacate a contaminated area to avoid chronic radiation exposure from deposited radioactive material.

Sampling refers to collecting specimens of materials at field locations.